

Development of an integrated design system for computer holography

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1. Introduction

Recently, various rendering techniques for creating polygon-based high-definition computer-generated holograms (HD-CGH) have been reported. By using these techniques, several HD-CGHs such as “Shion” [1], “Metal Venus II” [2], and “Brothers” [3] are created and reported. Furthermore, in digitized holography that records the field of a real-existing physical object by digital holography and reconstructs it as CGHs [4], a CGH named “Hamsters” is reported, in which several resized real objects and virtual objects are arranged in the scene [5]. We call these techniques for creating CGHs *Computer Holography*. The 3D scene in computer holography is composed of various material sources such as polygon-meshes, real-existing object field, pictures, photos, and multi-viewpoint images. However, these holograms are currently designed and produced by researchers in computer holography, because programming is required for creating CGHs, and thus, programming skills and knowledge of wave optics is necessary for the creation. As a result, it is very difficult for designers, who are non-expert in computer holography but expert in art & design, to design and create their own holographic works. In this paper, we report development status of an integrated design system for computer holography that is designed both for non-expert designers and expert researchers in computer holography. In this paper, we present the outline of the system and an example of creating HD-CGHs by using the interactive design tool included in our integrated system.

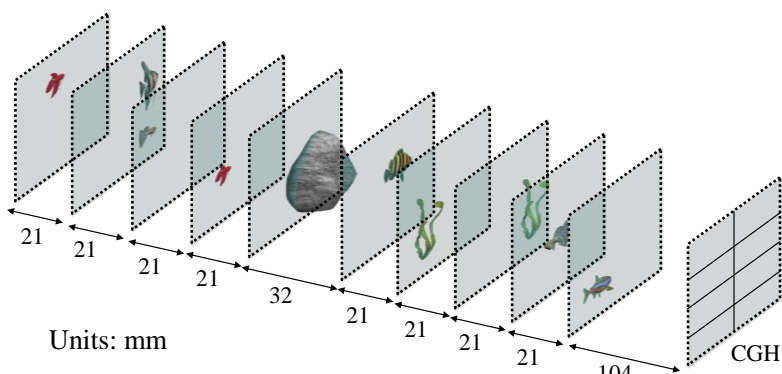
2. The integrated design system

The Integrated design system consists of an interactive design tool and programming libraries for saving the designed 3D scenes as XML-format files. The interactive design tool is intended to be used by designers who are non-expert in computer holography but expert in art & design. Thus, the tool has a GUI that makes it possible to preview the 3D scene, arrange source materials and set parameters of the materials. Designers can create the scene only by adding and editing the materials, as they verify the 3D scene on the PC screen.

The programming library included in the system is C++ class libraries in that components corresponding to source materials are defined and handled. These components composing a 3D scene have types such as 3D objects expressed by polygon-mesh models, 2D objects by digital images or digital wave-fields of a real object. Each type has common parameters such as the position in the scene and specific parameters such as shading parameters. The scene data expressed as components and the lists is easily saved as XML-format files and reused by using methods implemented in the library. Therefore, a 3D scene designed and saved by artists using the interactive design tool, can be reused by researchers in order to create CGHs by their original codes or algorithms.

3. Making of a hologram using the interactive design tool

The 3D scene is shown in Fig.1. This scene is only composed of polygon-meshed 3D objects without any other type of materials. Each 3D object is rendered by UV texture mapping. The main window of the tool is shown in Fig.2. The component list is indicated on the upper-right pane of the window. By pressing “Edit” or “Add” button, the parameter setting panel for the selected components is opened, as shown in Fig.3. In this panel, designers set the material file such as polygon mesh files prepared by using conventional CG modeler. Designers also set the positions in the scene and some other detailed parameters. This sequence is repeated as



Number of pixels	131,072 × 65,536
Pixel pitches	0.8μm × 1.0μm
Number of segment	2 × 4
Number of objects	10
Viewing angle (H × V)	47° × 37°

Fig.1 the 3D scene of a hologram "Aqua3"

checking the scene preview in the main window. When finishing the scene design, designers set hologram parameters such as sampling number or intervals required to start calculation of the wave-field for the scene. As a result, only using this tool, designers can synthesize the field of the designed 3D scene. The optical reconstruction of the hologram designed by this tool is shown in Fig.4.

4. Conclusion

We are developing the integrated design system for computer holography that is mainly for non-expert designers in computer holography. The interactive tool included in the system makes it possible to produce a hologram with high designability. This work was supported by research grants from the JSPS (KAKENHI, 24500113) and the MEXT strategic research foundation at private universities (2013-2017).

References

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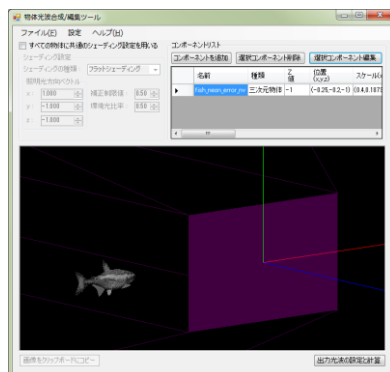


Fig.2 The main window of the interactive design tool.

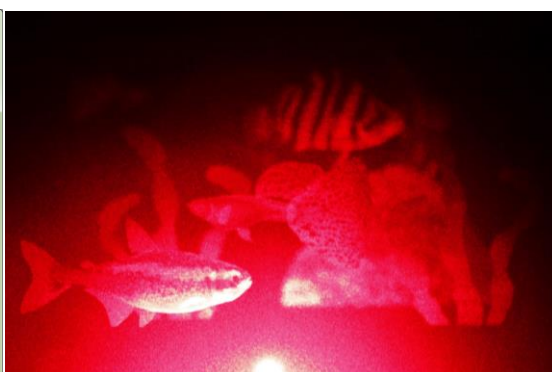


Fig.4 Optical reconstruction of "Aqua3" designed by the interactive design tool.

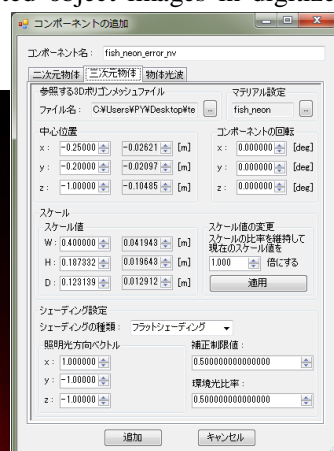


Fig.3 The panel for component parameters.